(19) European Patent Offic
Office européen des brevets

(11) EP 0 865 772 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
23.09.1998 Bulletin 1998/39

(51) Int Cl.[6]: **A61F 2/00**, A61B 17/12, A61F 2/01

(21) Application number: **98301894.6**

(22) Date of filing: **13.03.1998**

(84) Designated Contracting States:
AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **17.03.1997 US 819611**

(71) Applicant: **SARCOS, INC.**
Salt Lake City Utah 84108 (US)

(72) Inventors:
- **Jacobsen, Stephen C.**
  Salt Lake City, Utah 84102 (US)
- **Lippert, John A.**
  Park City, Utah 84098 (US)
- **Davis, Clark C.**
  Salt Lake City, Utah 84109 (US)

(74) Representative: **Thomson, Paul Anthony et al**
Potts, Kerr & Co.
15, Hamilton Square
Birkenhead Merseyside L41 6BR (GB)

(54) Catheter deliverable thrombogenic apparatus and method

(57) A catheter deliverable thrombogenic device includes a catheter for threading into a body vasculature passageway to a target location, and a resilient wire element coiled and shaped to occupy a certain volume when unconstrained, and to straighten when inserted lengthwise into and constrained by the catheter, for ultimate discharge therefrom to expand and occupy the target location. The wire element includes a plurality of cuts on the exterior surface thereof at selected locations to increase the flexibility of the wire element.

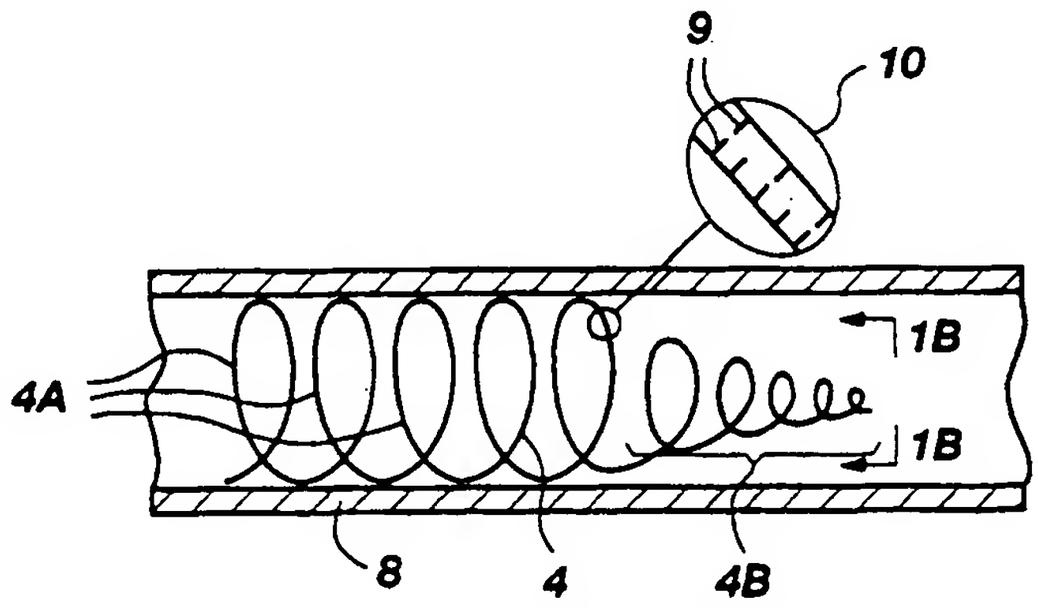

Fig. 1A

EP 0 865 772 A1

Printed by Jouve, 75001 PARIS (FR)

7, 1995, and incorporated herein by reference. By appropriate spacing of the cuts both circumferentially and longitudinally and by varying the depth and width of the cuts, desired flexibility and shape can be achieved. For example, generally spacing the cuts closer together and making them wider and deeper provides greater flexibility and vice versa. Cuts in the wire 4 also enhance the wire's thrombogenicity, and provide sites for holding clotting agents or other drugs to be deposited in the blood vessel.

The wire 4 might, for example, be formed of a highly elastic nickel-titanium alloy wire with directionally specific cuts and having an outside diameter of about .008 inch to .060 inch. The diameter of the larger diameter section 4a advantageously is from about 3 to 12 mm whereas the diameter of the smallest diameter coil in section 4b advantageously is from about 1 to 2 mm, both calculated when the coil wire 4 is unconstrained.

Tapering the diameter of the wire coil 4 as in section 4b provides a greater barrier and density (of occlusion wires) to the flow of blood, and thus greater ability to occlude, as best seen in the FIG. 1B view, taken along lines 1B--1B of FIG. 1A. (Controlling the tapering of [and spacing between] coils allows use of the coil as a limited leak valve or a complete block.

The coil wire 4 may either be a solid wire or a tubular wire, of the general dimensions discussed above. If tubular, and formed with cuts on the exterior surface, some of those cuts could be made to extend through the tubular walls to the interior and then medication placed in the hollow of the tube to gradually leak from the cuts after the coil wire were put in position at the target site. In this manner, the thrombogenic function of the coil wire 4 is augmented by a medication delivery function. Also, thrombogenic fibers could be disposed in the hollow of a tubular wire to enhance occlusion and clotting.

FIG. 2 shows a side, fragmented, cross-sectional view of a wire coil 4 partially disposed in a catheter 12. For deployment of the coil wire 4 to a target location in a vasculature passageway or other cavity in the body, the wire 4 may be threaded into the catheter 12 generally straight as shown in FIG. 2, and then pushed through the catheter by another guide wire (not shown) or similar device which serves as a type of plunger to force the coil wire out the distal end of the catheter where it then expands to seat itself at the target location. When deployed to a target site in the body past which blood is flowing, the wire coil 4 serves to slow the flow to allow for coagulation or clotting and ultimately the arresting of further flow. To aid in the clotting process, clotting agents, in the form of a solution, might be delivered through the catheter 12 along with the deployment of the coil wire 4, to the target site. Alternatively, such solution could be disposed in a tubular wire coil 4 to gradually leak from the tube through side cuts which extend through the tubular walls, as previously discussed above.

The embodiment of the wire coil 4 shown in FIG. 2 includes a narrowed distal section 4b in which the coils are tightly wound to the extent that the adjac nt coils touch. With such high density packing of the coils, the flow of blood is substantially stopped even before coagulation or clotting takes place.

FIG. 3 shows a side, fragmented view of a wire 32 having cuts 36 formed in the exterior surface thereof. The wire 32 could be either solid or tubular, and would be formed into a coil having a tapered distal end, such as shown in FIG. 1A. The cuts 36 would be placed, as earlier described, to control the flexibility and shape along the length of the wire. These cuts could be formed either by saw cutting or three-dimensional etching such as described in U.S. Patent No. 5,106,455.

Radiopaque bands 40 may be wrapped about the wire 32 at predetermined locations along the length thereof to allow tracking movement of the wire in a vasculature passageway in the body. Thrombogenic fibers 44 made, for example, of Dacron® or other polymers are attached to the wire 32 at certain locations, preferably where cuts have been made. The fibers 44 could be tied into the wire 32, attached by an adhesive, fused or other well-known bonding method. These fibers promote the clotting and coagulation of blood flowing past the wire 32 which, of course, is the desired result.

It is to be understood that the above-described arrangements are only illustrative of the application of the principles of the present invention. Numerous modifications and alternative arrangements may be devised by those skilled in the art without departing from the spirit and scope of the present invention and the appended claims are intended to cover such modifications and arrangements.

Claims

1. Thrombogenic apparatus comprising

   a catheter for threading into a body vasculature passageway to a target location, and
   a resilient wire means shaped to occupy a certain volume when unconstrained, and to straighten when inserted lengthwise into and constrained by the catheter, for ultimate discharge therefrom to expand and occupy the target location, said wire means including a plurality of cuts on the exterior surface thereof at selected locations, to increase the flexibility of the wire means.

2. An apparatus as in Claim 1 wherein said wire means is formed into a coil having a diameter which becomes gradually smaller toward a distal end.

3. An apparatus as in Claim 2 wherein the smaller diameter coils near and at the distal end are tightly wound to inhibit flow of blood therepast, when in-

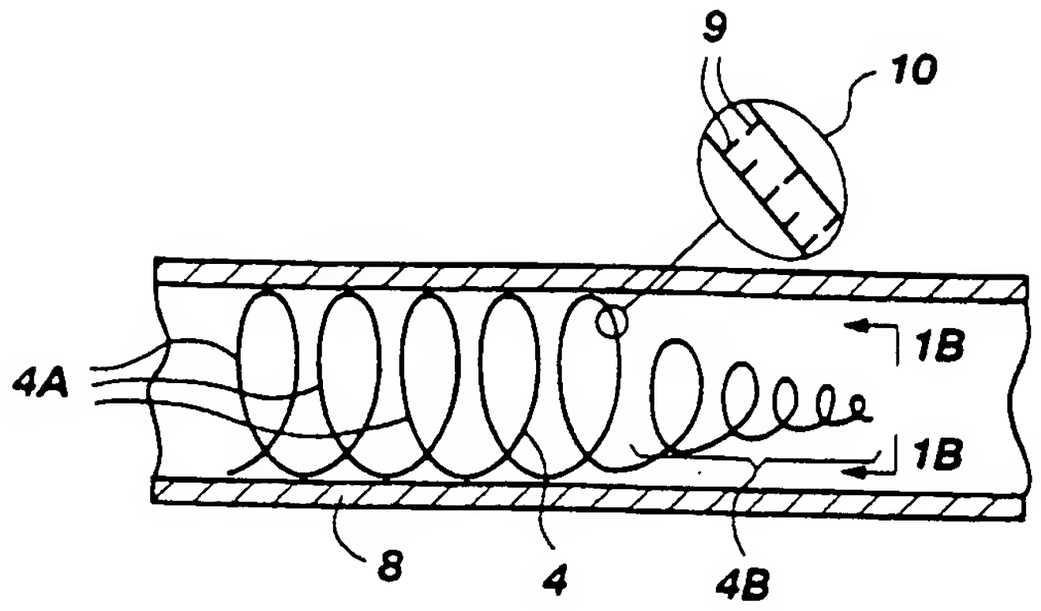

Fig. 1A

Fig. 1B

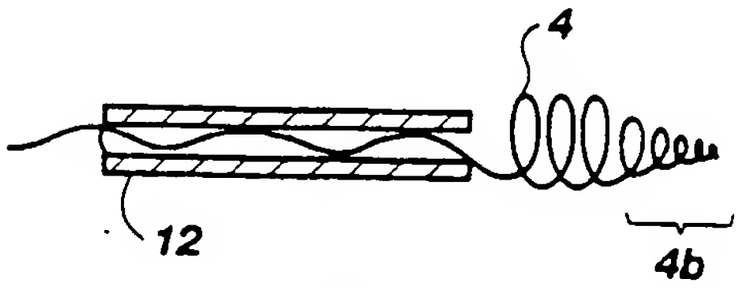

Fig. 2

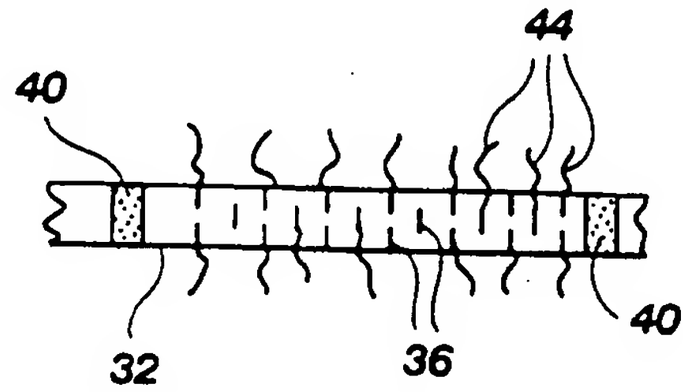

Fig. 3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 98 30 1894

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	WO 95 25480 A (TEKULVE) 28 September 1995 * the whole document *	1-3.5.7. 15-17	A61F2/00 A61B17/12 A61F2/01
A	EP 0 739 608 A (TARGET THERAPEUTICS INC) 30 October 1996 * the whole document *	1.5.6.15	
A	EP 0 743 047 A (UNIV SOUTH CAROLINA) 20 November 1996 * column 5, line 33 - column 6, line 14 *	1.13.15	
A	WO 92 14408 A (NEUSS MALTE) 3 September 1992 * the whole document *	1.8.15	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

A61B
A61F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	5 August 1998	Verelst, P

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)